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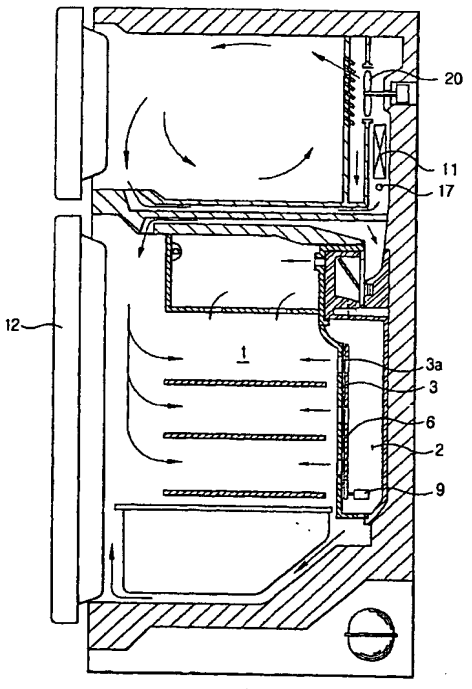
## (54) Refrigerator

(57) A refrigerator is capable of preventing heat exchange between an evaporator (11) and ambient air during a defrosting operation and/or when a door (12) is open. The refrigerator has a device for opening/closing cool air discharge ports (3a) between a cool air duct (2) and a fresh food compartment (1). The opening/closing device includes opening/closing member (6; 26; 36) for opening/closing the cool air discharge ports (3a) and a driving device (9, 7; 18; 26, 26a, 27, 29; 37, 38, 39, 41, 42) for driving the opening/closing member (6; 26; 36). The cooling efficiency is enhanced and the frost caused by the ambient air is not generated on the evaporator (11).

FIG. 2

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## Description

The present invention relates to a refrigerator including an evaporator, a cooling air duct for guiding cooling air from the evaporator, the duct having an opening in a wall thereof into a fresh food compartment.

Referring to Figure 1, a prior art refrigerator has a body 14 defining a freezing compartment 15 and a fresh food compartment 1, first and second doors 16, 12 to the freezing compartment 15 and the fresh food compartment 1 respectively, a compressor 19 for compressing refrigerant, an evaporator 11 for generating cool air by evaporating the refrigerant supplied from the compressor 19, and a fan 20 for blowing the cool air generated by the evaporator 11.

A duct member 3, forming a cool air duct 2, is installed at the back of the fresh food compartment 1. The duct member 3 has a plurality of cool air discharge ports 3a opening into the fresh food compartment 1. Cool air blown by the fan 20 flows into the cool air duct 2, and is then discharged into the fresh food compartment 1 through the cool air discharge ports 3a. A guide device 13 for guiding the cool air flowing into the cool air duct 2 toward the cool air discharge ports 3a is installed in the cool air duct 2.

While the refrigerator is operating, frost forms on the evaporator 11, lowering its efficiency. To deal with this, the refrigerator is equipped with a heater 17 for removing the frost. The heater 17 is operated periodically to remove frost that has formed on the evaporator 11.

In such a prior art refrigerator, the heat generated by the heater 17 during the defrosting operation is transmitted into the fresh food compartment 1. This is undesirable. The heat generated by the heater 17 is mainly transmitted through the cool air path. That is, the heat is mainly transmitted to the fresh food compartment 1 through the cool air duct 2 and the cool air discharge ports 3a. Due to the heat transmitted to the fresh food compartment 1, the cooling efficiency of the fresh food compartment 1 is lowered, and the status of the food stored therein cannot be maintained properly.

Furthermore, when a user opens the door 12 of the fresh food compartment 1, the warm ambient air flows into the fresh food compartment 1, mainly into the area adjacent to the evaporator 11. When the ambient air flows toward the evaporator 11, much more frost forms on the evaporator 11. This means that the defrosting operation must be performed more frequently resulting in more heat flowing from the heater 17 to the fresh food compartment 1.

A refrigerator according to the present invention is characterised by a closure means comprising a member having an aperture and drive means configured to drive said member parallel to said wall so as to bring the aperture out of and into alignment with opening, thereby blocking and unblocking the opening.

Preferably, defrosting control means, operable to periodically energise a heater for defrosting the evaporator and operate the drive means so as to block the opening when the heater is energised, is included.

Preferably, a door open sensor, for sensing opening of a fresh food compartment door, and anti-frosting control means, responsive to the door open sensor to operate the drive means so as to block the opening when the fresh food compartment door is opened, are included.

Preferably, there is a plurality of openings in said wall into the fresh food compartment and said member has an aperture for each of said openings.

The drive means may comprise a motor and a cam drivingly connected to the motor, in which case the member rests on the cam so as to be moved thereby. Preferably, a spring means is provided for holding the member in contact with the cam.

The drive means may comprise a motor, a pinion gear drivingly connected to the motor and a rack mounted to the member and engaged by the pinion gear.

The drive means may comprise a motor mounted to the member, a pinion gear drivingly connected to the motor and a L-shaped rack stationary relative to the wall and engaged by the pinion gear, the rack being arranged such that the member moves perpendicular to the wall as the or each opening becomes blocked.

Embodiments of the present invention will now be described, by way of example, with reference to Figures 2 to 9 of the accompanying drawings, in which:-

Figure 1 is a side sectional view of a prior art refrigerator;
Figure 2 is a side sectional view of a first refrigerator according to the present invention;
Figure 3 is an enlarged perspective view of the opening/closing device shown in Figure 2;
Figure 4 is a side sectional view of Figure 3;
Figure 5 is a variant of the opening/closing device shown in Figures 2 through 4;
Figure 6 is an enlarged perspective view of another opening/closing device according to the present invention;
Figure 7 is a side sectional view of Figure 6;
Figure 8 is an enlarged rear perspective view of yet another opening/closing device according to the present invention; and
Figure 9 is a side sectional view of Figure 8.

Parts common the refrigerators described below and the above-described refrigerator will not be described again. However, the same reference numbers will be used.

Referring to Figures 2 to 5, an opening/closing device for opening/closing the cool air discharge ports 3a is installed the cool air duct 2. The opening/closing device includes an opening/closing member 6, a cam 7, and a driving motor 9. The opening/closing member 6 is located by channels 4 formed at the duct member 3.

The opening/closing member 6 is in close contact

with the duct member 3. The opening/closing member 6 has a plurality of air holes 5 associated with respective the cool discharge ports 3a. The cam 7 is disposed under the opening/closing member 6 and supports the opening/closing member 6. The opening/closing member 6 is kept in contact with the cam 7 by its own weight.

The driving motor 9 is fixed by a bracket (not shown) towards the bottom of the cool air duct 2. The cam 7 is mounted on the shaft 8 of the driving motor 9. When the driving motor 9 operates, the cam 7 is rotated, and the opening/closing member 6 is driven up and allowed to fall by the action of the cam 7. When the opening/closing member 6 is moved up, the cool air discharge ports 3a are opened as shown in Figure 4, and when the opening/closing member 6 is falls, the cool air discharge ports 3a are closed by the opening/closing member 6.

During the cooling operation of the refrigerator, the opening/closing member 6 keeps the cool air discharge ports 3a open, as shown in Figure 4. However, when the defrosting operation of the refrigerator begins, a control part, which is not shown, energises the driving motor 9 to rotate the cam 7 so that the opening/closing member 6 falls, closing the cool air discharge ports 3a.

When a user opens the second door 12 during the cooling operation of the refrigerator, the opening of the second door 12 is sensed by a sensor (not shown) and the control part responds by energising the driving motor 9 to close the cool air discharge ports 3a as described above.

As described, the cool air discharge ports 3a are closed during the defrosting operation when the heater 17 is generating heat and when the door 12 opened. Consequently, the transmission of the heat from the heater 17 to the fresh food compartment 1 and the transmission of the outside air to the evaporator when the second door 12 is opened are prevented. Therefore, the lowering of the cooling efficiency is prevented, and the frost caused by the outside air is not generated on the evaporator 11.

Referring to Figure 5, in a modified form, the opening/closing device is equipped with a spring 18 for applying a downward elastic force to the opening/closing member 6. The spring 18 connects the bottom of the duct member 3 and the bottom of the opening/closing member 6. The opening/closing member 6 held in close contact with the cam 7 by the spring 18, and the up-and-down movement of the opening/closing member 6 due to the rotation of the cam 7 is efficiently performed.

Referring to Figures 6 and 7, in another embodiment, the opening/closing device includes an opening/closing member 26 formed with a plurality of air holes 25 associated with cool air discharge ports 3a of the duct member 3, a rack 26a formed at the lower part of the opening/closing member 26, a pinion 27 engaged with the rack 26a, and a driving motor 29 for driving the pinion 27. The opening/closing member 26 is held in place by channels 24 formed at the duct member 3.

When the pinion 27 is rotated by the driving motor 29, the opening/closing member 26 is moved up or down depending on the direction of rotation of the driving motor 29. When the opening/closing member 26 is moved up, the cool air discharge ports 3a are opened, and when the opening/closing member 26 is moved down, the cool air discharge ports 3a are closed. The operation of the opening/closing member 26 is the same with that of the embodiment shown in Figures 2 through 4. That is, the opening/closing device closes the cool air discharge ports 3a during the defrosting operation and/or when the second door 12 is opened.

Referring to Figures 8 and 9, in yet another embodiment, the opening/closing device includes an opening/closing member 36 formed with a plurality of air holes 35 associated with respective cool air discharge ports 3a of the duct member 3, a driving motor 39 mounted on the opening/closing member 36 by a fixing bracket 39a, and a driving gear 37 installed at the shaft 38 of the driving motor 39.

A plurality of protrusion parts 46 are formed at the frontal side of the opening/closing member 36. The protrusion parts 46 are form-fittingly inserted into the cool air discharge ports 3a when the opening/closing member 36 closes the cool air discharge ports 3a. Therefore, the cool air discharge ports 3a are airtightly closed.

A guide protrusion 48 is formed at the side of the opening/closing member 36. The guide protrusion 48 is inserted into a guide hole 43.

The duct member 34 is formed with a guide bracket 34 for guiding the movement of the opening/closing member 36 along the vertical direction, and a long hole 41 is formed at the guide bracket 34. The long hole 41 is formed vertically, and the upper part thereof is bent toward the front. A gear teeth 42 is formed on the inside of the long hole 41.

The driving gear 37 is inserted into the long hole 41 and engages the gear teeth 42 formed at the long hole 41. When the driving gear 37 is rotated by the driving motor 39, the driving gear 37 is moved up and down in the long hole 41. Then the driving motor 39 is moved up and down, and the opening/closing member 36 on which the driving motor 39 is fixed is moved up and down.

The guide bracket 34 is formed with a guide hole 43. The guide hole 43 is formed into a shape substantially the same with the shape of the long hole 41. The guide protrusion 48 of the opening/closing member 36 is inserted into the guide hole 43, whereby the up-and-down movement of the opening/closing member 36 is efficiently guided.

When the driving motor 39 begins to operate, the driving gear 37 moves up along the long hole 41, and thereby the opening/closing member 36 moves up. As the rotation of the driving motor 39 is continued, the opening/closing member 36 is moved toward the front along the long hole 41. Then the opening/closing member 36 comes in contact with the back of duct member 3. In this situation, since the long hole 41 is formed along the insertion direction of the protrusion parts 46 to the

cool air discharge ports 3a, the protrusion parts 46 are easily inserted into the cool air discharge ports 3a. When the driving motor 39 is driven in a reverse direction, the opening/closing member 36 is moved down, and the cool air discharge ports 3a are opened.

**Claims**

1. A refrigerator including an evaporator (11), a cooling air duct (2) for guiding cooling air from the evaporator (11), the duct (2) having an opening (3a) in a wall (3) thereof into a fresh food compartment (1), **characterised by** a closure means comprising a member (6; 26; 36) having an aperture (5; 25; 35) and drive means (9, 7; 18; 26, 26a, 27, 29; 37, 38, 39, 41, 42) configured to drive said member (6; 26; 36) parallel to said wall (3) so as to bring the aperture (5; 25; 35) out of and into alignment with opening (3a), thereby blocking and unblocking the opening (3a).

2. A refrigerator according to claim 1, including defrosting control means operable to periodically energise a heater (17) for defrosting the evaporator (11) and operate the drive means (9, 7; 18; 26, 27, 29; 37, 38, 39, 41, 42) so as to block the opening (3a) when the heater (17) is energised.

3. A refrigerator according to claim 2, including a fresh food compartment door (12), a door open sensor for sensing opening of the fresh food compartment door (12) and anti-frosting control means responsive to the door open sensor to operate the drive means (9, 7; 18; 26, 27, 29; 37, 38, 39, 41, 42) so as to block the opening (3a) when the fresh food compartment door (12) is opened.

4. A refrigerator according to claim 1, 2 or 3, wherein there is a plurality of openings (3a) in said wall (3) into the fresh food compartment (1) and said member (6; 26; 36) has an aperture (5; 25; 35) for each of said openings (3a).

5. A refrigerator according to any preceding claim, wherein the drive means comprises a motor (9) and a cam (7) drivingly connected to the motor (9), and the member (6) rests on the cam (7) so as to be moved thereby.

6. A refrigerator according to claim 5, including a spring means (18) for holding the member (6) in contact with the cam (7).

7. A refrigerator according to any one of claims 1 to 4, wherein the drive means comprises a motor (29), a pinion gear (27) drivingly connected to the motor (9) and a rack (26a) mounted to the member (26) and engaged by the pinion gear (27).

8. A refrigerator according to any one of claims 1 to 4, wherein the drive means comprises a motor (39) mounted to the member (36), a pinion gear (37) drivingly connected to the motor (39) and a L-shaped rack (42) stationary relative to the wall (3) and engaged by the pinion gear (37), the rack (42) being arranged such that the member (36) moves perpendicular to the wall (3) as the or each opening becomes blocked.

9. A refrigerator comprising:

   a door for opening/closing a cooling compartment;
   an evaporator for generating cool air to be supplied into said cooling compartment by evaporating refrigerant;
   a heater for removing frost generated on said evaporator;
   a duct member for forming a cool air duct into which the cool air generated by said evaporator flows, said duct member being formed with a plurality of cool air discharge ports opened in said cooling compartment; and
   an opening/closing device including an opening/closing member being in close contact with said duct member, said opening/closing member being formed with air holes corresponding to the cool air discharge ports, a cam being disposed under said opening/closing member, said cam for supporting said opening/closing member, and a motor for driving said cam so that said cool air discharge ports are opened/closed by said opening/closing member, wherein
   said opening/closing device closes the cool air discharge ports during a defrosting operation of said heater and/or when said door is open.

10. The refrigerator as claimed in claim 9, further comprising a spring for forcing said opening/closing member so that said opening/closing member is in elastic contact with said cam.

11. A refrigerator comprising:

    a door for opening/closing a cooling compartment;
    an evaporator for generating cool air to be supplied into said cooling compartment by evaporating refrigerant;
    a heater for removing frost generated on said evaporator;
    a duct member for forming a cool air duct into which the cool air generated by said evaporator flows, said duct member being formed with a

plurality of cool air discharge ports opened in said cooling compartment; and
an opening/closing device including an opening/closing member being in close contact with said duct member, said opening/closing member being formed with air holes corresponding to the cool air discharge ports, a rack being formed in a body with said opening/closing member, a pinion being engaged with said rack, and a motor for driving said pinion so that said cool air discharge ports are opened/closed by said opening/closing member, wherein
said opening/closing device closes the cool air discharge ports during a defrosting operation of said heater and/or when said door is open.

**12.** A refrigerator comprising:

a door for opening/closing a cooling compartment;
an evaporator for generating cool air to be supplied into said cooling compartment by evaporating refrigerant;
a heater for removing frost generated on said evaporator;
a duct member for forming a cool air duct into which the cool air generated by said evaporator flows, said duct member being formed with a plurality of cool air discharge ports opened in said cooling compartment; and
an opening/closing device including an opening/closing member being in close contact with said duct member, said opening/closing member being formed with air holes corresponding to the cool air discharge ports, a motor being fixed on said opening/closing member, a driving gear being rotated by said motor, said driving gear being inserted into a long hole formed on said duct member, and a gear part being formed at an inner side of the long hole, said gear part being engaged with said driving gear, said opening/closing device for opening/closing the cool air discharge ports by moving said opening/closing member, wherein
said opening/closing device closes the cool air discharge ports during a defrosting operation of said heater and/or when said door is open.

**13.** The refrigerator as claimed in claim 12, wherein said opening/closing member is formed with protrusion parts being form-fittingly inserted into the cool air discharge ports when the cool air discharge ports are closed thereby.

**14.** The refrigerator as claimed in claim 13, wherein the long hole is bent so that said protrusion parts is moved to be inserted into the cool air discharge ports when said opening/closing member is operated to close the cool air discharge ports.

**15.** The refrigerator as claimed in claim 14, wherein said duct member is formed with a guide hole for guiding said opening/closing member, and said opening/closing member is formed with a guide protrusion being inserted into the guide hole.

FIG. 1

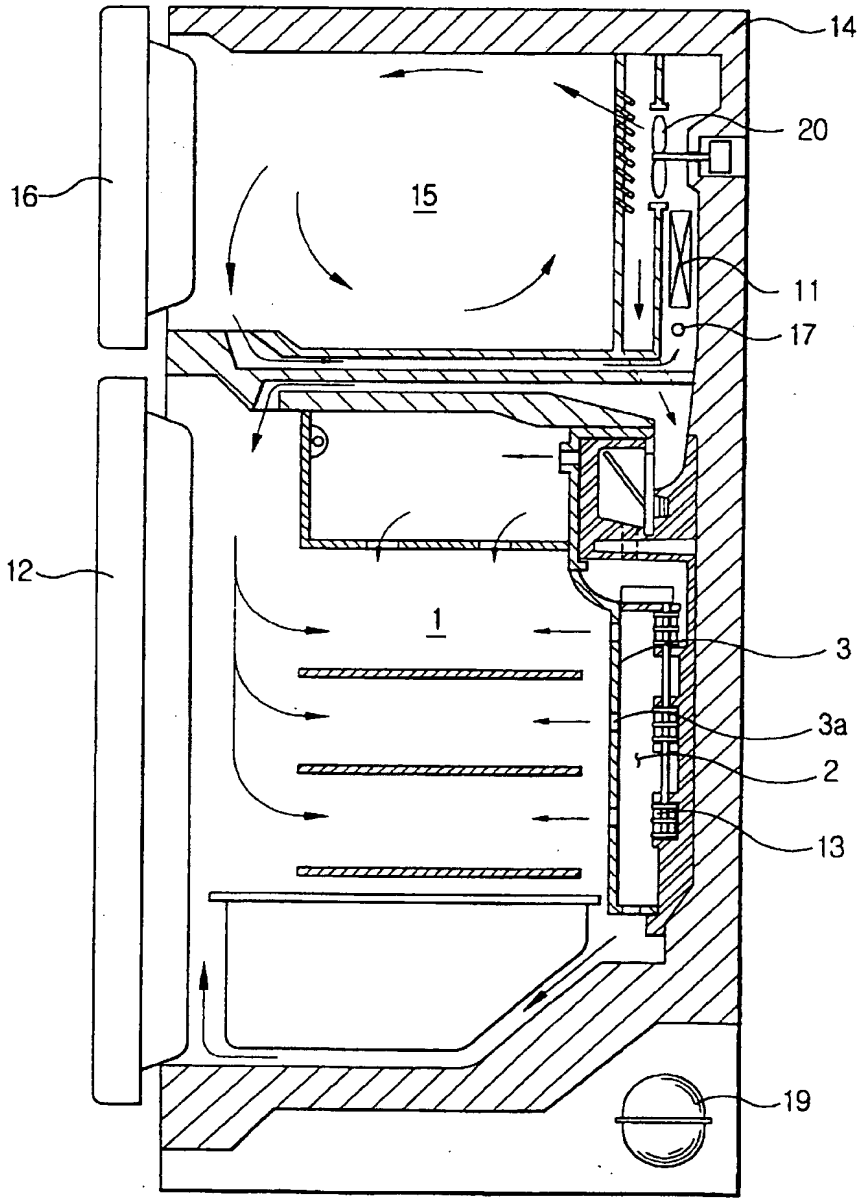

FIG. 2

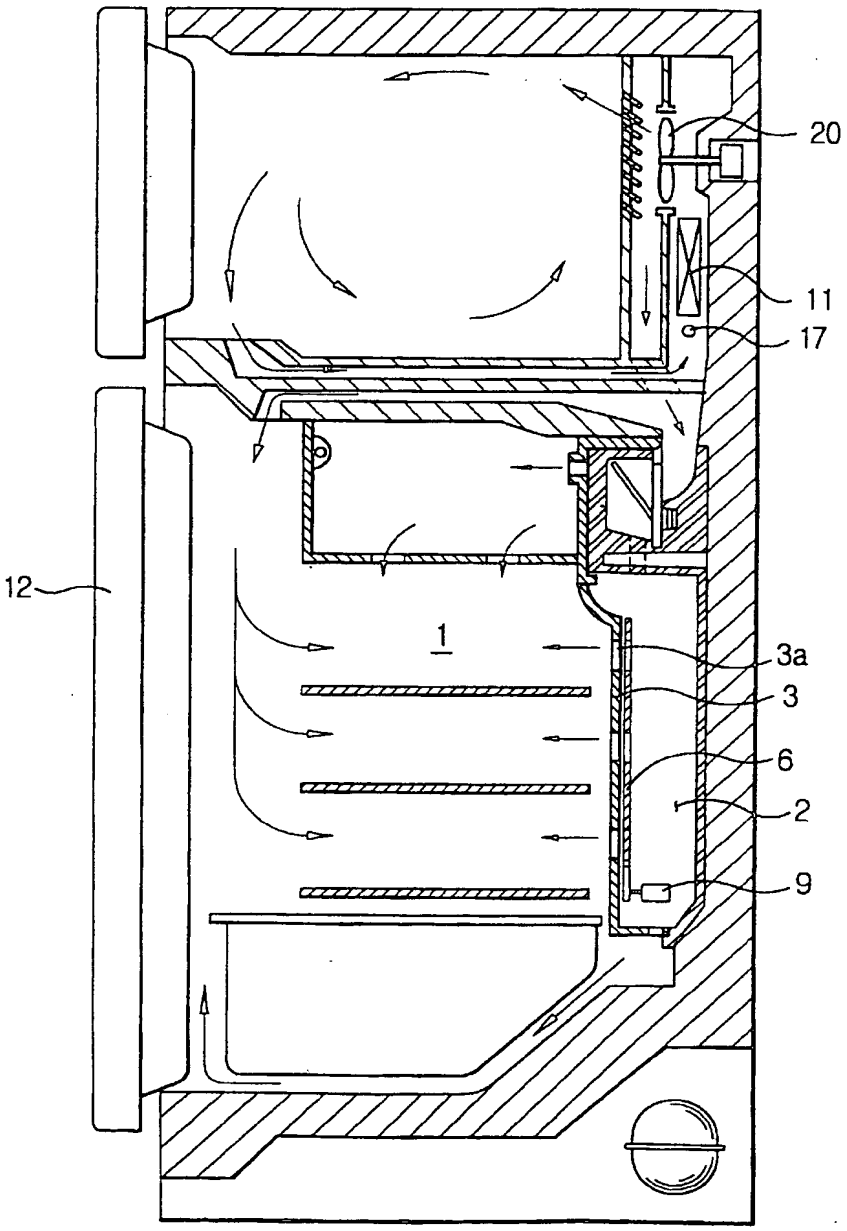

FIG. 3

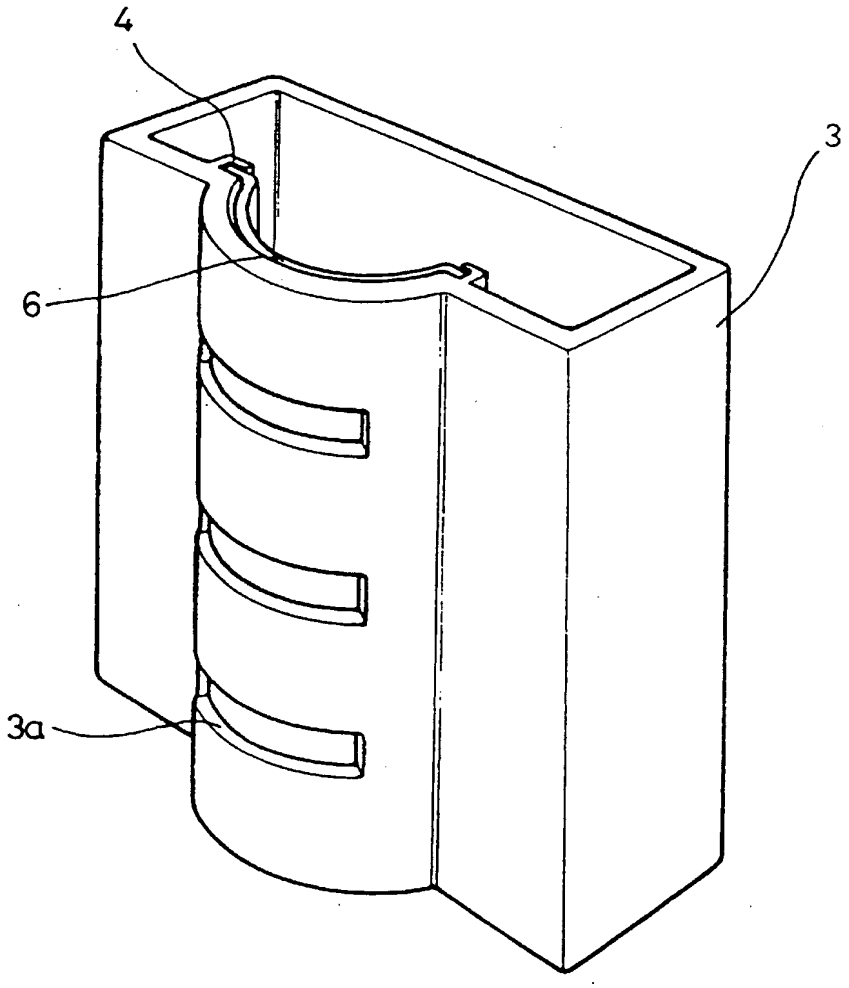

FIG. 4

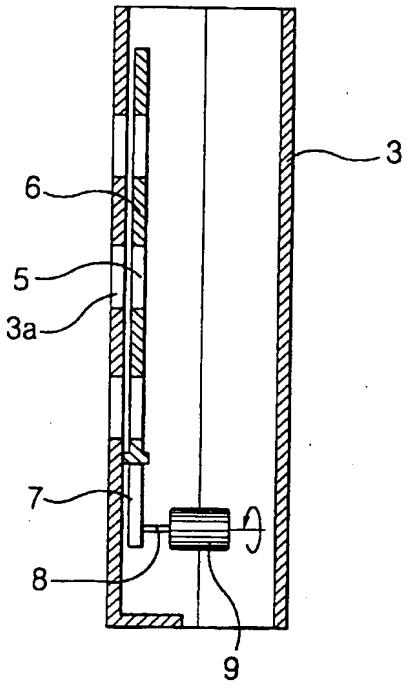

FIG. 5

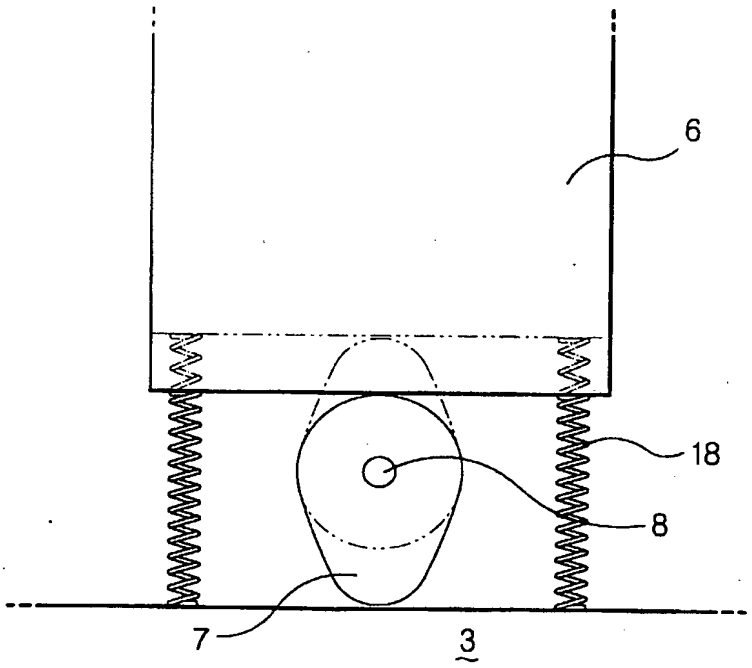

FIG. 6

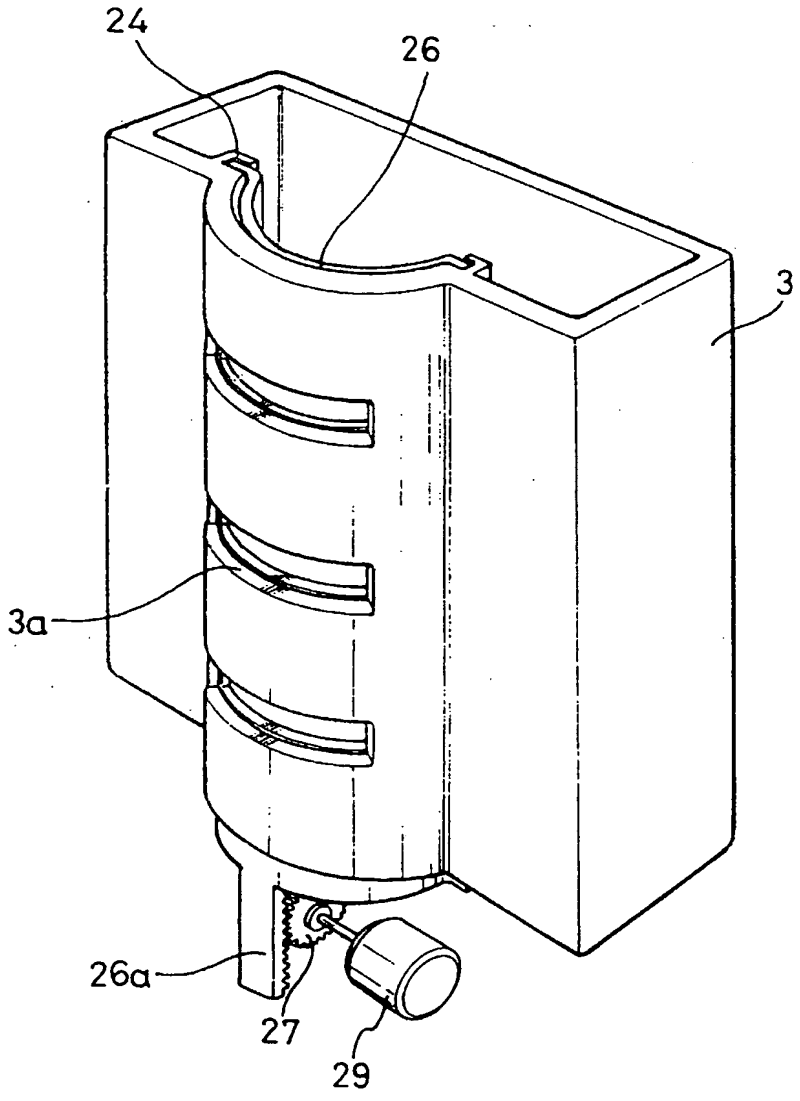

FIG. 7

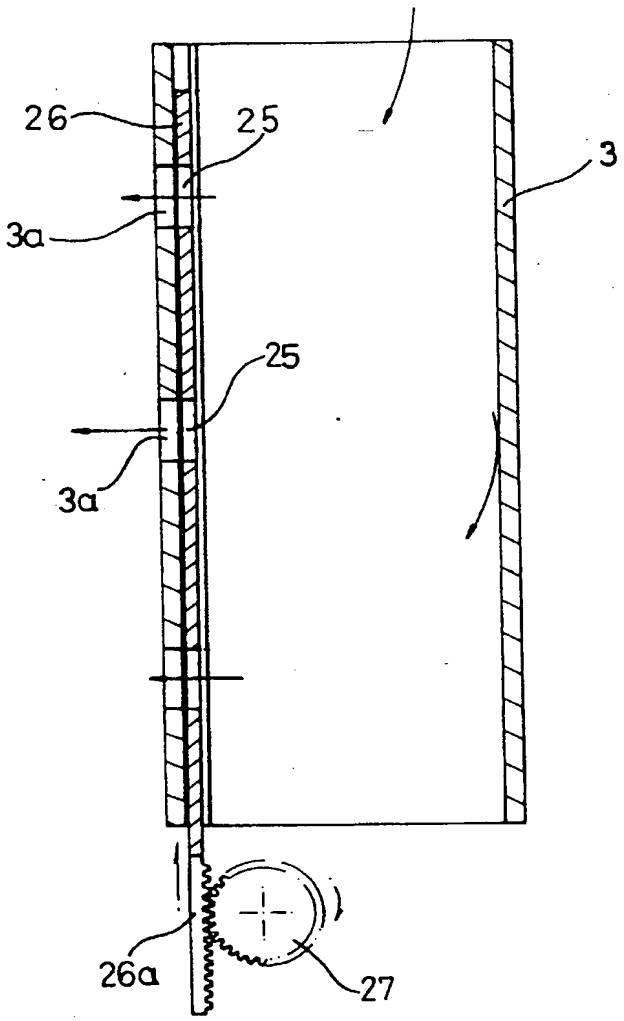

FIG. 8

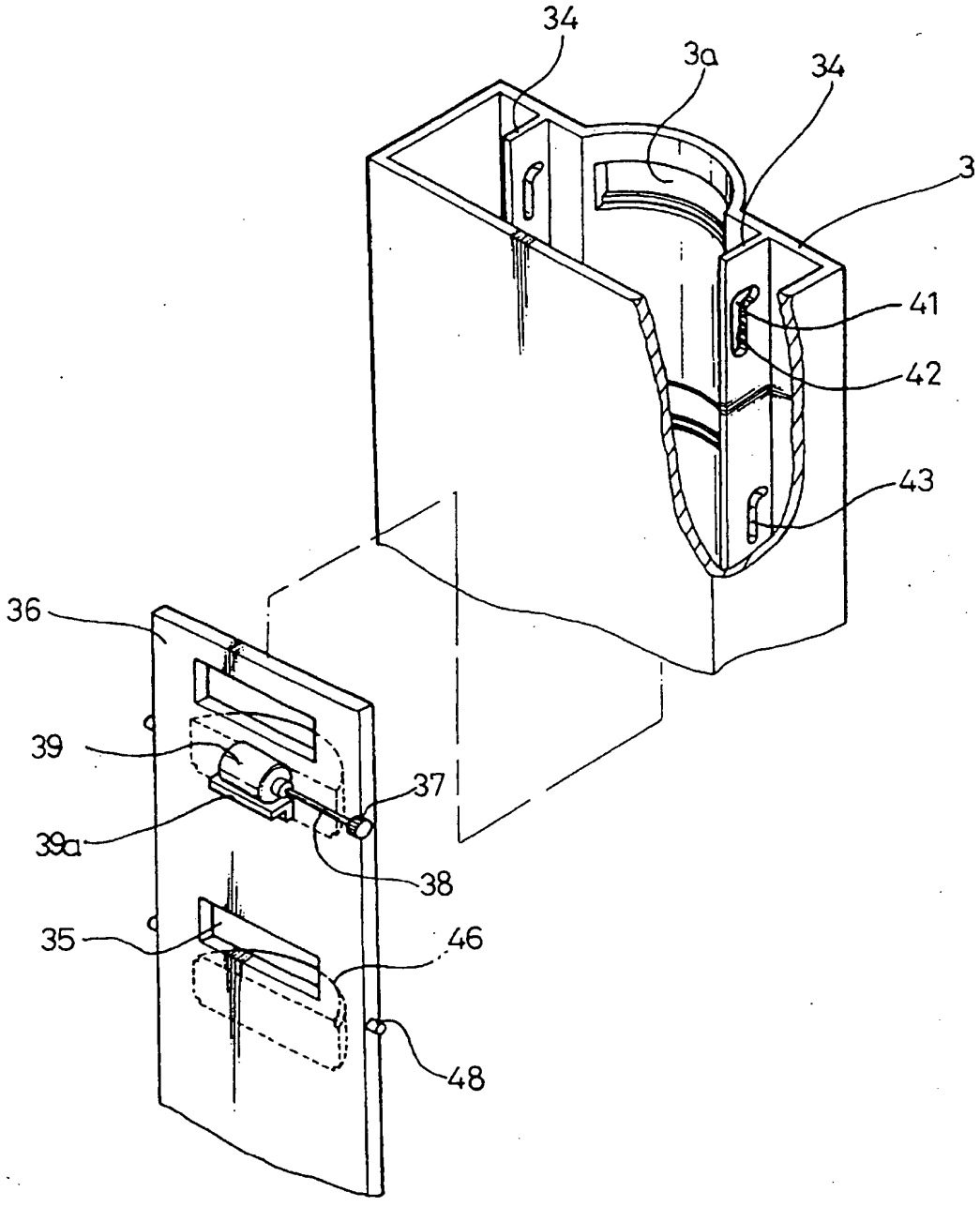

FIG. 9